Journal of Traumatic Stress, Vol. 23, No. 3, June 2010, pp. 331–339 (© 2010) CE ARTICLE

Heterogeneity in the Course of Posttraumatic Stress Disorder: Trajectories of Symptomatology

Benjamin D. Dickstein and Michael Suvak
National Center for PTSD and Boston University

Brett T. Litz
National Center for PTSD, Boston University, Boston University School of Medicine, and Massachusetts Veterans Epidemiological Research and Information Center

Amy B. Adler
U.S. Army Medical Research Unit-Europe and Walter Reed Institute of Research

Unconditional and conditional trajectories of posttraumatic stress disorder (PTSD) symptomatology were examined using a sample of U.S. soldiers deployed on a NATO-led peacekeeping mission to Kosovo. Data were collected at 4 time points, ranging from the weeks leading up to deployment to 9-months postdeployment. Latent class growth analysis revealed 4 unique symptom trajectories: resilience, recovery, delayed, and unrealized anxiety. Variables identified as significant predictors of trajectory class included previous traumatic events, combat exposure, peacekeeping daily hassles, depression, alcohol use, aggressive behavior, stress reactivity, and military rank. Results from this study add to the literature detailing the variability in PTSD course, as well as to the literature pertaining to predictors of PTSD onset and course.

Based primarily on cross-sectional research, it appears that in the wake of potentially traumatic events (PTEs) and other operational stressors, most service members do not develop posttraumatic stress disorder (PTSD), and are, in effect, resilient (e.g., Litz & Schlenger, 2009). However, because of a dearth of longitudinal and prospective studies it is unclear whether resilience at a given point in time changes to a delayed and subsequently chronic condition and the factors that predict resilience over time are unknown.

Benjamin D. Dickstein and Michael Suvak, National Center for PTSD, VA Boston Healthcare System, and Department of Psychology, Boston University; Brett T. Litz, National Center for PTSD, VA Boston Healthcare System, Department of Psychology, Boston University, Boston University School of Medicine, and Massachusetts Veterans Epidemiological Research and Information Center, Amy B. Adler, U.S. Army Medical Research Unit-Europe, and Walter Reed Institute of Research.

Material has been reviewed by the Walter Reed Army Institute of Research. There is no objection to its presentation and/or publication. The opinions or assertions contained herein are the private views of the authors, and are not to be construed as official, or as reflecting true views of the Department of the Army or the Department of Defense.

The authors would like to thank Lolita Burrell, Carl Castro, Dennis McGurk, and Jeffrey Thomas for data collection support in Kosovo and Angela Salvi, Coleen Crouch, Sandra Kelley, Rachel Eckford, Erica Schroeder, Deena Carr, Nicole Sinclair, Kaisha Haig, Jessica Ippolito, and Kathleen McConnell for research support in Germany.

Correspondence concerning this article should be addressed to: Benjamin D. Dickstein, National Center for Post-Traumatic Stress Disorder, Behavioral Science Division (116-B5), Boston Department of Veterans Affairs Medical Center, 150 South Huntington Avenue, Boston, Massachusetts 02130. E-mail: Benjamin.Dickstein@va.gov.

 Published online in Wiley InterScience (www.interscience.wiley.com) DOI: 10.1002/jts.20523

Numerous variables have been identified as potential risk factors for the onset of PTSD in the general population. Two meta-analyses have found that demographics, pretrauma functioning, characteristics of the traumatic event, and posttraumatic factors predict PTSD onset to varying degrees (Brewin, Andrews, & Valentine, 2000; Ozer, Best, Lipsey, & Weiss, 2003). Nevertheless, much remains unexplained; the total variability explained by the sum of all predictors in these meta-analyses was less than 20% (Ozer et al., 2003).

In addition, recent longitudinal studies have examined predictors of PTSD among deployed military personnel. Using data collected as part of the Millennium Cohort Study (e.g., Ryan et al., 2007), researchers have found female gender, a history of previous assault, poor physical and mental health functioning at baseline, and exposure to combat to confer significant risk for the development of PTSD (Leardmann, Smith, Smith, Wells, & Ryan, 2009; Smith, Ryan, et al., 2008; Smith, Wingard, et al., 2008).

Although these data add to our understanding of risk and resilience factors among service members, they tell us little about variability within the course of adaptation to military trauma. Given that PTSD symptomatology is dynamic, it is important to identify prototypical patterns of adaptation to trauma (i.e., trajectories of symptomatology) so that these may be tested in relation to predictors, rather than simply cross-sectional measures of symptom severity. Although not specific to the military, large-scale epidemiological studies suggest considerable variability in PTSD course over time (see Breslau et al, 1999).

Most of the research on course has, to date, used samples of motor vehicle accident survivors (e.g., Bryant, Harvey, Guthrie, & Moulds, 2003; Kuhn, Blanchard, Fuse, Hickling, & Broderick, 2006), which has questionable generalizability to the military. Variables that have been identified in these studies as predictors of worsening over time include female gender, persistent medical problems, increased heart rate at initial posttrauma assessment, and psychiatric comorbidity. Studies using other trauma groups (primary care and emergency room patients) to investigate predictors of adaptation (e.g., Freedman, Brandes, Peri, & Shalev, 1999; Zlotnick et al., 2004) have found psychiatric comorbidity to consistently predict PTSD persistence.

On a conceptual level, Bonanno (2004) offered a model of putative patterns, or trajectories, of disruption in functioning following potentially traumatic events and loss. He hypothesized four symptom trajectories: chronic, delayed, recovery, and resilience. Resilient individuals are proposed to never exhibit a significant disruption in functioning, whereas those in the recovery trajectory demonstrate a marked acute reaction, followed by a gradual decline in symptoms over time. Delayed response is proposed to consist of a subsyndromal response for the first 6-months posttrauma, followed by a subsequent abrupt increase in symptoms over time. Chronic cases are categorized as having the most severe initial symptom response in the acute stage, and demonstrate persistence in symptomatology across time.

The prototypical patterns of disruption theorized by Bonanno (2004) can be tested using new latent class analytic strategies (e.g., latent class growth analysis, growth mixture modeling), which enable researchers to identify distinct growth curves depicting the nature of change across time in homogenous subgroups. Two studies have employed this type of analysis to examine the course of adaptation to military trauma (Elliott, Biddle, Hawthorne, Forbes & Creamer, 2005; Orcutt, Erickson, & Wolfe, 2004). Elliott and colleagues examined treatment response over time in a sample of Vietnam veterans with chronic PTSD, and Orcutt et al. conducted a descriptive study of PTSD symptom trajectories using a sample of Gulf War veterans.

The results of both studies revealed significant heterogeneity within PTSD course. Elliott et al. (2005) found three unique trajectories and observed significant differences in treatment response associated with participants' initial symptom levels. Two of the trajectories demonstrated a mild decrease in symptoms subsequent to treatment, followed by sustained chronicity. The third trajectory demonstrated a mild increase in symptoms following treatment, and then a gradual return to baseline.

Orcutt et al. (2004) identified two distinct trajectories: one characterized by low levels of initial PTSD symptoms with little increase over time (i.e., resilience), and the other by higher levels of initial symptoms with a significant increase over time (i.e., delayed). In addition to depicting the nature of adaptation associated with each latent class, Orcutt et al. found gender, race, education, and combat exposure to significantly predict latent class membership. Respectively, being male, identifying as White, higher education, and lower levels of combat exposure predicted the less symptomatic class.

This study extends the work of Orcutt et al., utilizing group-based latent growth modeling to examine the course of PTSD symptoms in a large sample of U.S. peacekeepers. Importantly, it addresses limitations of previous research by including a predeployment time point to account for baseline functioning, as well as a sufficient number of time points to examine nonlinear change. By utilizing group-based latent growth modeling to analyze the data, we sought to identify variability within the course of adaptation to military deployment, as well as examine how predictors of PTSD relate to different trajectories of symptomatology. This approach differs markedly from most previous risk and resiliency research in that it seeks to identify risk factors associated with distinct forms of adaptive course, and does not assume one uniform trajectory class. Our aims were (a) to use group-based latent growth modeling to test for heterogeneity in PTSD course, (b) to identify the nature of the trajectories best fitting the data and compare these with the trajectories hypothesized in Bonanno's (2004) model, and (c) to examine the relationship between predictor variables and participants' assignment to latent class. Because rates of PTSD were relatively low in the current sample, we chose to examine symptom development rather than focus solely on individuals approximating the diagnostic threshold.

The predictors we included in our model have previously been shown to relate to PTSD (e.g., Brewin et al., 2000; Ozer et al., 2003), and were assessed either at predeployment or immediately following deployment. An increased understanding of the ways in which these variables relate to trajectories of PTSD symptomatology will promote better identification of individuals at high risk for chronicity, and will help target those most in need of early intervention (e.g., Litz, 2004).

METHOD

Participants

Data for this study were originally collected as part of a randomized controlled trial, conducted by Adler et al. (2008), which compared the clinical effectiveness of critical incident stress debriefing (CISD) to stress management. Results from this study suggested that neither CISD nor stress management significantly impacted participants' rates of recovery from PTSD. Consistent with this finding, we found that treatment condition did not significantly relate to latent class assignment. All other variables included in our study were assessed prior to intervention.

The participants were 635 United States soldiers deployed on a 6-month NATO-led peacekeeping mission to Kosovo. All participants included in the study completed questionnaires administered at Time 1 (predeployment) and Time 2 (late deployment). Three-hundred ninety-four participants (62%) completed assessments at

Time 3 (3–4 months postdeployment), and 171 (27%) were assessed at Time 4 (8–9 months postdeployment). Participants were primarily male ($n = 617$; 97.0%) and White ($n = 331$; 52.1%). Mean age was 25 years ($SD = 5.6$), and the majority of participants had not attended college for any length of time ($n = 389$; 61.3%). Participants' mean number of years in the military was 4.6 ($SD = 4.8$). Roughly 8% ($n = 53$) had previous combat experience, and 26% ($n = 167$) had previously served on a peacekeeping or humanitarian mission. The sample was split about evenly with regard to marital status. Participants reported experiencing an average of 1.65 PTEs (e.g., "being shot at") while deployed.

Measures

Posttraumatic stress disorder symptom severity was assessed using the Posttraumatic Stress Disorder Checklist (PCL; Blanchard, Jones-Alexander, Buckley, & Forneris, 1996; Weathers, Litz, Herman, Huska, & Keane, 1993), which consists of 17 items assessing each of the criteria according to the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (*DSM-IV*; American Psychiatric Association, 1994). Recommended cutoff scores for caseness vary across studies and study groups. The most applicable and best-designed validation study of the PCL using service members was conducted by Bliese et al. (2008). In this study, a cutoff score of 34 was determined to have the most utility. The PCL demonstrated excellent internal consistency in the current sample ($\alpha = .93$).

Exposure to PTEs and mission stressors (e.g., "being attacked or ambushed" and "being shot at") was captured with the 24-item revised Peacekeeping Events Scale. Participants were asked to rate the degree to which they were impacted by PTEs using a response format ranging from *did not experience* to *severe impact*. This scale is based on items originally used in Gulf War and peacekeeping research (e.g., Castro, Bienvenu, Huffman, & Adler, 2000), and was developed and supplemented based on feedback from U.S. soldiers returning from peacekeeping deployments to the Balkans (Adler, Dolan, Bienvenu, & Castro, 2000). The internal reliability for the current sample was good ($\alpha = .83$). Peacekeeping daily hassles (e.g., "difficult sleeping conditions" and "lack of privacy or personal space") were assessed using a modified version of the Deployment Stressor Scale (e.g., Castro et al., 2000; Britt & Adler, 1999). The measure demonstrated excellent internal reliability in the current sample ($\alpha = .92$). Previous trauma was assessed using the Life Events Checklist (LEC; Gray, Litz, Hsu, & Lombardo, 2004). The LEC consists of 16 items inquiring about previous traumatic experiences. Its response format ranges from *happened to me* to *does not apply*. The internal reliability for the current sample was good ($\alpha = .87$).

Depression was evaluated using the nine-item version of the Center for Epidemiological Studies-Depression Scale (CES-D; Radloff, 1977; Santor & Coyne, 1997). The CES-D demonstrated good internal consistency in the current sample ($\alpha = .81$). Alcohol use was assessed with the Alcohol Users Disorder Identification Test (AUDIT; Babor, Higgins-Biddle, Saunders, & Monteiro, 2001). Internal reliability in the current sample was good ($\alpha = .80$). Aggressive behavior (e.g., "threatened someone with physical violence") was measured using a nine-item revised version of the Conflict Tactics Scale (CTS; Straus, 1979). This scale assesses outward expressions of anger, a form of behavior that has repeatedly been linked with PTSD symptomatology (e.g., Orth & Wieland, 2006). The internal reliability of the CTS in the current sample was good ($\alpha = .77$).

In addition, two personality traits, social closeness and stress reactivity, were evaluated using the Multidimensional Personality Questionnaire (Tellegen, 1982). The Multidimensional Personality Questionnaire consists of 11 primary state scales; however, due to concerns regarding questionnaire length, only two scales were administered to participants. The 12-item social closeness subscale and a 12-item revised version of the stress reaction subscale were used. Inclusion of these measures is supported by research suggesting social cohesion to have a palliative effect on PTSD (e.g., McTeague, McNally, & Litz, 2004), and by research linking stress reactivity with increased PTSD symptom severity (e.g., Feldner, Lewis, Leen-Feldner, Schnurr, & Zvolensky, 2006). Both the social closeness and stress reaction subscales of the Multidimensional Personality Questionnaire demonstrated good internal consistency; Cronbach's alpha for both measures was .84. Coping strategy, which is believed to play a role in the onset and maintenance of PTSD symptoms (e.g., Dörfel, Rabe, & Karl, 2008), was assessed using a 24-item measure (Harnish, Aseltine, & Gore, 2000) that asked participants to rate how they would cope with a stressful situation. This scale is comprised of six subscales, each addressing a different type of coping strategy; these include cognitive based (e.g., "think about strategies for dealing with the situation"), appraisal based (e.g., "try to see things in a positive way"), religious based (e.g., "pray about or meditate on the situation"), behavioral-based coping methods (e.g., "do things to improve the situation"), support seeking (e.g., "talk to someone about how you felt"), and avoidance (e.g., "do things to take your mind off the situation"). The internal consistency of the coping subscales ranged from good ($\alpha = .75$; avoidant coping) to excellent ($\alpha = .93$; religious coping). Lastly, the OMRON wrist blood pressure monitor (European Model #RXI; Omron Healthcare, Inc., Bannockburn, IL) was used to assess participants' resting heart rates at predeployment. Inclusion of this measure is supported by previous research suggesting a positive correlation between an elevated resting heart rate and subsequent PTSD (e.g., Bryant et al., 2003).

Procedure

Soldiers were recruited as they rotated through pre- and post-deployment processing being held at a base gymnasium. During this time, individuals were uncertain whether they would be deployed. Informed consent was obtained from all participants.

Questionnaires were used to evaluate the participants prospectively at four separate time points. The evaluations took place during the weeks leading up to deployment in April 2002 (predeployment, T1), the last month of deployment in October to November 2002 (late deployment, T2), 3–4 months postdeployment in January to February 2003 (T3), and 8–9 months postdeployment in September to November 2003 (T4).

Data Analysis

Due to standard military rotation policies (e.g., sick and leave time), attrition is known to be a common limitation of research involving the prospective examination of military units (e.g., Adler et al., 2008). With regards to the dependent variable, the PCL, data were obtained from 605 (95%) participants at T1, 628 (98%) participants at T2, 381 (60%) participants at T3, and 166 (26%) participants at T4. In total, 120 (19%) participants responded to the PCL at all four time points, 285 (45%) responded at three time points, 215 (34%) responded at two time points, and 15 (2%) responded at only one time point.

Because military rotation policies and human error likely explain most of the missing data in our sample, we assumed that these data were missing at random (MAR; e.g., Switzer & Roth, 2002). Accordingly, we employed a missing data algorithm found in MPlus version 5.1 that imputes data using a full information maximum likelihood (FIML) approach (e.g., Arbuckle, 1996). A FIML approach assumes that data are MAR (e.g., Buhi, Goodson, & Neilands, 2008), and is therefore an appropriate technique for handling the data missing in the present sample. A FIML approach was employed with the PCL data only; participants missing data for the predictor variables were excluded from the conditional model analyses. In total, 61 participants (10%) were excluded for this reason from the conditional model solution. To test whether the number of assessment points completed was associated with latent class membership, we ran an additional conditional model analysis and found this to be a nonsignificant predictor. In addition, we conducted a point-biserial correlation to test the relation between missingness on the PCL and resilient class assignment; we found this to be nonsignificant.

Latent class growth analysis (LCGA) was used to model growth curves. This form of group-based latent growth modeling assumes that various trajectories are distinct and not simply linear continua, and it is capable of fitting multiple qualitatively distinct growth trajectories (Jung & Wickrama, 2008). One noted limitation of LCGA is that it does not allow variation to occur around the mean growth curves within a latent class (Muthén & Muthén, 2000). Although one alternative form of latent growth modeling, growth mixture modeling (GMM), does allow such variation, it specifies a model with more unknown parameters than LCGA. Because Bonanno's theory hypothesizes curvilinear patterns of adaptation to trauma, we wanted to include a quadratic factor in our unconditional and conditional growth models. A growth mixture model containing a quadratic factor would require more identified parameters than are available with the present dataset, and would result in an underidentified model. Latent class growth analysis was therefore used to model growth curves.

The number of latent classes best fitting the data was established using an unconditional growth model. Next, the predictors of trajectory class membership were entered into a conditional growth model. A Wald test of parameter constraints was used to test the statistical significance of the predictors. Mplus version 5.1 was used to perform all analyses.

Goodness of fit statistics considered when examining latent class solutions included the Bayesian information criterion (BIC), the sample-size adjusted BIC, the Akaike information criterion (AIC), the Lo-Mendell-Rubin likelihood ratio test, average latent class probabilities of group membership, and entropy. Group solutions were also considered from a theoretical perspective, and it was required that solutions assign at least 1% of the sample to each class. The most favored group solution is one having the lowest BIC, lowest sample-size adjusted BIC, lowest AIC, a significant Lo-Mendell-Rubin likelihood ratio test, latent class membership probabilities approaching a value of 1.0 (and probabilities for assignment to other groups approaching 0), and a high entropy value approaching 1.0.

RESULTS

Unconditional Model

Goodness of fit comparisons were made between unconditional trajectory group models ranging in size from 2 to 5 groups. The 4-group solution had the smallest BIC value (Table 1), the smallest sample-size adjusted BIC value, and the smallest AIC value. These results are consistent with good model fit. Group assignment accuracy was next examined (Table 2). Membership probability matrices suggested that a 5-group solution was not viable. The 4-group solution, however, had probabilities ranging from .92 to .98 for most likely group assignment and values approximating 0 for likelihood of assignment to all other groups. It was therefore consistent with good model fit. The entropy value for the 4-group solution approached 1.0, and was also consistent with good model fit. In contrast, the Lo-Mendell-Rubin likelihood ratio test was statistically significant only for the 2-group solution. However, because all other goodness of fit indicators suggested that the 4-group solution fit the data best, it was selected as the unconditional model solution and is depicted graphically in Figure 1. Borrowing from Bonanno's model, we termed these classes: resilience, recovery, delayed, and unrealized expectations.

The first trajectory, resilience, described 84% of the current sample. Participants assigned to this trajectory showed consistent, low levels of PTSD symptomatology across all four time points. The intercept growth parameter for this group indicated that group members initially endorsed few symptoms of PTSD ($B = 19.85$,

Table 1. Goodness of Fit Statistics for Unconditional Group-Based Models

Model	BIC	Sample-size adjusted BIC	AIC	Lo-Mendell-Rubin likelihood ratio test	Entropy
2-group	12073.01	12038.09	12024.02	523.47 (p < .01)	0.975
3-group	11836.10	11788.48	11769.30	252.92 (p = .17)	0.948
4-group	11686.81	11626.49	11602.19	168.58 (p = .42)	0.950
5-group	11712.62	11639.60	11610.19	−55.54 (p = .62)	0.599
4-group (including covariates)	10276.40	10070.05	9993.48	–	0.958

Note. BIC = Bayesian information criterion; AIC = Akaike information criterion.

SE B = .29, 95% CI = 19.28–20.43, $p < .01$), and the linear ($B = -.33$, *SE B* = .38, 95% CI = −1.08–0.41, *ns*) and quadratic ($B = -0.13$, *SE B* = 0.11, 95% CI = −0.35–0.08, *ns*) change parameters indicated that this group did not display significant change over time in PTSD symptoms. Delayed, the second trajectory, represented 3% of the sample. These participants demonstrated moderate symptom levels at Time 1 and 2, followed by a steady increase in symptoms at Time 3 and 4. The intercept growth parameter for this group indicated that group members initially endorsed a moderate level of symptom severity (B = 33.12, *SE B* = 3.51, 95% CI = 26.17–40.06, $p < .01$); however, the linear ($B = -1.45$, *SE B* = 4.13, 95% CI = −9.63–6.73, *ns*) and quadratic (B = 2.21, *SE B* = 1.38, 95% CI = −0.52–4.94, *ns*) change parameters did not indicate a significant increase in symptoms. These change parameters are inconsistent with the graphical depiction of the delayed trajectory and may reflect the lack of change observed in this group between Time 1 and Time 2. Nine percent of the sample was assigned membership to the third trajectory, unrealized expectations. Members of this group were characterized by a relatively higher level of symptom severity at predeployment, followed by a marked decrease at Time 2, and a low level of symptom severity at Time 3 and 4. The intercept growth parameter for this group indicated that group members initially reported a high level of symptom severity (B = 42.94, *SE B* = 1.91, 95% CI = 39.15–46.72, $p < .01$), and the linear (B = −20.41, *SE B* = 1.98, 95% *CI* = −24.32–−16.50, $p < .01$) and quadratic (B = 4.04, *SE B* = 0.49, 95% CI = 3.07–5.01, $p <$ .01) change parameters indicated a significant decrease in symptoms over time. The final trajectory, recovery, consisted of low predeployment symptomatology, high symptom severity at Time 2 and 3, and a return to baseline at Time 4. Four percent of the sample was assigned membership to the *recovery* trajectory. The intercept growth parameter for this group indicated that group members initially reported few symptoms of PTSD (B = 20.92,

Table 2. Average Latent Class Probabilities for Most Likely Latent Class Membership

Group number	Group 1	Group 2	Group 3	Group 4	Group 5
1	0.959	0.041			
2	0.003	0.997			
1	0.983	0.015	0.002		
2	0.040	0.952	0.008		
3	0.032	0.008	0.960		
1	0.983	0.003	0.013	0.001	
2	0.020	0.912	0.038	0.030	
3	0.058	0.019	0.922	0.001	
4	0.034	0.034	0.000	0.932	
1	0.516	0.002	0.001	0.472	0.010
2	0.023	0.887	0.029	0.021	0.041
3	0.028	0.037	0.909	0.026	0.000
4	0.000	0.000	0.000	0.000	0.000
5	0.045	0.023	0.001	0.041	0.889

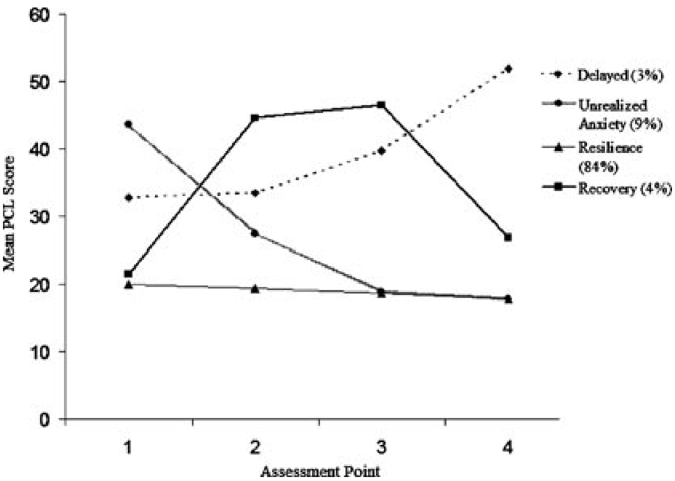

Figure 1. Longitudinal course of posttraumatic stress disorder (PTSD) symptoms across four time points as suggested by the unconditional 4-group model solution. PCL = PTSD Checklist.

Table 3. Estimated Odds Ratios (95% Confidence Interval) for Predictors of Latent Class

	1	2	3	4
1 Delayed	–			
2 Recovery	Peacekeeping daily hassles 1.04 (1.00–1.08)	–		
3 Resilience	Peacekeeping daily hassles .96 (.92–.99) Previous trauma .96 (.93–1.00) Depression .80 (.69–.93) Alcohol .92 (.84–1.00)	Peacekeeping daily hassles .92 (.90–.95) Depression .82 (.71–.94)	–	
4 Unrealized anxiety	Peacekeeping daily hassles .95 (.91–1.00)	Peacekeeping daily hassles .91 (.88–.95)	Previous trauma 1.04 (1.00–1.07) Stress reactivity 1.23 (1.06–1.44) Depression 1.25 (1.11–1.40)	–

Note. Odds ratios were generated by comparing the classes listed vertically to those listed above.

$SE\ B = 3.65$, 95% CI = 13.70, 28.14, $p < .01$), and the linear ($B = 38.96$, $SE\ B = 3.50$, 95% CI = 32.04–45.89, $p < .01$) and quadratic ($B = -12.69$, $SE\ B = 1.05$, 95% CI = -14.77–-10.61, $p < .01$) change parameters indicated significant change over time in PTSD symptoms.

Conditional Model

Following selection of the 4-group solution, potential predictors of latent class membership were entered into the analytic model, further improving model fit (Table 1). Inclusion of these variables served a dual purpose: first, to contribute to the estimation of the parameters comprising the latent class trajectories (i.e., intercept and linear and quadratic change over time) and second, to test their relationship with latent class assignment. The covariates entered into the conditional model included demographic variables (race, age, rank, and education), trauma exposure variables (previous traumatic events, peacekeeping daily hassles, and combat exposure), psychiatric comorbidity variables (depression, aggressive behavior, and alcohol use), personality (social closeness and stress reactivity) and coping strategy variables (behavioral, cognitive, avoidant, appraisal, religious, and support-seeking), and resting heart rate. With two exceptions, predictor variables were comprised of data collected at the predeployment assessment point. Peacekeeping daily hassles and combat exposure variables were comprised of data collected at the late-deployment assessment point.

The conditional LCGA provides estimates of odds ratios and 95% confidence intervals for each predictor of latent class membership. Predictor variables were grouped by type (demographics, trauma exposure variables, psychiatric comorbidities, personality and coping variables, and heart rate), and tested as separate analytic models. Significant predictors from these analyses were then included in a final combined model. Previous traumatic events, peacekeeping daily hassles, combat exposure, stress reactivity, depression, alcohol use, aggressive behavior, rank, age, and education were found to significantly predict latent class assignment. When these variables were combined into one model and regressed simultaneously onto latent class assignment, two predictors (age and education) failed to retain statistical significance. The odds ratios and confidence intervals, generated from a final regression containing all of the significant predictors, are presented in Table 3. These statistics provide comparisons between all of the latent classes and their predictors. It is important to note that given the number of comparisons made, these findings may be susceptible to Type I error; however, the overall significance of the predictors was first examined using a Wald test of parameter constraints. In addition, many of these associations border on the null and may suggest relatively weak levels of prediction.

Group Characteristics

Resilience was associated with low levels of depression at predeployment, peacekeeping daily hassles, and previous trauma. Assignment to the delayed trajectory was found to be related to high levels of daily hassles, depression at predeployment, and alcohol use. Individuals in the unrealized anxiety group reported low levels of daily hassles and high levels of stress reactivity. Lastly, recovery was associated most significantly with daily hassles. The mean values of each predictor are presented in Table 4.

DISCUSSION

Latent class growth analysis on a large group of Army peacekeepers revealed four distinct trajectories or courses of adaptation, indexed by the PCL. Three of the four trajectories resembled those depicted

Table 4. Latent Class Predictor Descriptives

	Delayed		Recovery		Resilience		Unrealized anxiety	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Combat exposure	28.48	8.34	29.63	10.33	25.07	4.19	25.55	3.57
Peacekeeping daily hassles	66.35	18.83	76.11	15.41	47.68	17.18	49.77	17.79
Previous trauma	23.39	10.23	20.58	13.72	14.82	11.09	20.86	10.89
Stress reactivity	4.79	3.25	4.19	3.50	2.48	2.63	6.13	3.23
Depression	18.39	5.27	17.41	4.08	12.98	3.25	18.30	4.65
Alcohol	10.26	6.55	7.44	4.98	5.36	4.65	7.04	5.09
Aggressive behavior	2.28	2.15	1.63	1.76	0.61	1.23	1.45	1.63
Military rank	3.58	1.32	3.67	1.22	4.60	2.57	3.71	2.00

in Bonanno's (2004) hypothesized scheme. A novel trajectory, unrealized anxiety, was also found. This type of adaptation may be unique to the military, particularly when predeployment state is considered. We also did not find the chronic trajectory (i.e., persistently high levels of symptom severity over time) predicted by Bonanno. This may be explained, in part, by the level of stressor exposure experienced by this unique study group (e.g., on average less exposed to PTEs than combat veterans).

Of the 19 potential predictors of group membership, 8 were found to significantly relate to latent class assignment: previous traumatic events, combat exposure, peacekeeping daily hassles, stress reactivity, depression, alcohol use, aggressive behavior, and rank.

It should be noted that although the results of the conditional LCGA allowed comparison between all of the latent classes, the most salient differences were seen between resilient individuals and those assigned to the three other classes. Relative to other individuals, resilient individuals perceived fewer deployment hassles and reported, on average, less previous trauma, stress reactivity, depression, alcohol use, and aggressive behaviors (Table 4). This generally healthier profile is consistent with previous research examining predictors of resilience following trauma (e.g., Bonanno, Galea, Bucciarelli, & Vlahov, 2007).

Individuals assigned to the unrealized anxiety group reported the highest overall levels of stress reactivity. This finding suggests that, leading up to deployment, a stress-reactive disposition may cause high anticipatory anxiety that manifests as PTSD symptoms. However, this personality variable does not prevent an individual from learning that they can manage various demands while deployed. Interestingly, although participants assigned to this group reported significantly more previous trauma than those in the resilient class, no differences were observed between the unrealized anxiety, recovery, and delayed groups with regards to previous trauma. This finding further supports the argument that a stress-reactive disposition may best explain assignment to unrealized anxiety, rather than preexisting PTSD symptoms.

We were unable to find any salient predictors differentiating individuals assigned to the delayed and recovery groups. Although those in the recovery group reported more peacekeeping daily hassles than participants assigned to the delayed group, this difference bordered on the null. More research is needed examining other predictors of latent class membership. It could be that while resilient individuals demonstrate an overall healthier profile, certain key predictors are able to distinguish between other trajectories of PTSD. Notably, the predictors found to be most robust in previous meta-analytic research (Brewin et al., 2000; Ozer et al., 2003), social support and peritraumatic dissociation, were not tested in the current study.

Several limitations to this study should be underscored. First, this study tracked the longitudinal course of PTSD for roughly 10 months. Although this assessment period sufficiently captured a variety of symptom trajectories, longer periods of assessment are needed to observe long-term outcomes. Second, because military units were followed during the data collection period, standard rotation policies (e.g., leave and sick call) caused response rates to vary across the different assessment points. It is unclear whether the use of the missing data algorithm biased our trajectory findings (i.e., overestimated the likelihood of resilience). However, 98% of our sample reported PCL data at two or more time points and 64% reported data at three or more points. Given that assignment to resilience requires an absence of symptoms at all time points, we believe it unlikely that this trajectory was overestimated. This claim is further supported by the nonsignificant correlation observed between missingness and resilient class assignment. Third, it remains unknown whether these findings are generalizable to other individuals exposed to different PTEs, as well as to combat veterans. Therefore, replication of the findings in other populations is necessary. Fourth, due to the small percentage of female participants in the sample, gender could not be included in the conditional model. Fifth, several of the conditional model analyses border on the null, again pointing to the need for these findings to be replicated. Finally, all of these data were collected through the use of self-report questionnaires. Although such measures may result in biased reporting (e.g., King et al., 2000), studies have demonstrated the reliability of PTE exposure reporting by veterans (e.g., Krinsley, Gallagher, Weathers, Kutter, & Kaloupek, 2003).

Notwithstanding the methodological concerns, this study takes an important step towards empirically validating theorized models of adaptation to trauma. There have been few studies within the trauma literature to employ LCGA, and no study to date has taken into account pre-exposure baseline state. These results suggest that there are several common patterns of adaptation following exposure to deployment stressors. Replication of these results may help to identify predictors associated with prototypical symptom trajectories.

In the future, pre-, peri-, and posttraumatic factors will greatly enhance and tailor primary and secondary preventions. Before the prediction of PTSD onset and course can reliably be made for any given individual, a large accumulation of data, spanning a variety of trauma groups and predictors, will be necessary. Latent class growth analysis will help efficiently analyze these data, allowing investigators the opportunity to simultaneously explore symptom trajectories and their predictors.

REFERENCES

Adler, A. B., Dolan, C. A., Bienvenu, R., & Castro, C. A. (2000). U.S. soldier peacekeeping experiences and wellbeing after returning from deployment to Kosovo. In Proceedings of the 36th International Applied Military Psychology Symposium (pp. 30–34). Split, Croatia: Ministry of Defense of the Republic of Croatia.

Adler, A. B., Litz, B. T., Castro, C. A., Suvak, M., Thomas, J. L., Burrell, L., et al. (2008). A group randomized trial of critical incident stress debriefing provided to U.S. peacekeepers. Journal of Traumatic Stress, 21, 253–263.

American Psychiatric Association. (1994). Diagnostic and statistical manual of mental disorders (4th ed.). Washington, DC: Author.

Arbuckle, J. L. (1996). Full information estimation in the presence of missing data. In G. A. Marcoulides & R. E. Schumaker (Eds.), Advanced structural equation modeling: Issues and techniques (pp. 243–277). Mahwah, NJ: Erlbaum.

Babor, T. F., Higgins-Biddle, J. C., Saunders, J. B., & Monteiro, M. G. (2001). The Alcohol Use Disorders Identification Test: Guidelines for use in primary care (2nd ed.). Geneva: World Health Organization, Department of Mental Health and Substance Dependence.

Blanchard, E. B., Jones-Alexander, J., Buckley, T. C., & Forneris, C. A. (1996). Psychometric properties of the PTSD Checklist (PCL). Behaviour Research and Therapy, 34, 669–673.

Bliese, P. D., Wright, K. M., Adler, A. B., Cabrera, O., Castro, C. A., & Hoge, C. W. (2008). Validating the Primary Care Posttraumatic Stress Disorder Screen and the Posttraumatic Stress Disorder Checklist with soldiers returning from combat. Journal of Consulting and Clinical Psychology, 76, 272–281.

Bonanno, G. A. (2004). Loss, trauma, and human resilience: Have we underestimated the human capacity to thrive after aversive events? American Psychologist, 59, 20–28.

Bonanno, G. A., Galea, S., Bucciarelli, A., & Vlahov, D. (2007). What predicts psychological resilience after disaster? The role of demographics, resources, and life stress. Journal of Consulting and Counseling Psychology, 75, 671–682.

Breslau, N., Kessler, R. C., Chilcoat, H. D., Schultz, L. R., Davis, G. C., & Andreski, P. (1998). Trauma and posttraumatic stress disorder in the community: The 1996 Detroit Area Survey of Trauma. Archives of General Psychiatry, 55, 626–632.

Brewin, C. R., Andrews, B., & Valentine, J. D. (2000). Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. Journal of Consulting and Clinical Psychology, 68, 748–766.

Britt, T. W., & Adler, A. B. (1999). Stress and health during humanitarian assistance missions. Military Medicine, 164, 275–279.

Bryant, R. A., Harvey, A. G., Guthrie, R. M., & Moulds, M. L. (2003). Acute psychophysiological arousal and posttraumatic stress disorder: A two-year prospective study. Journal of Traumatic Stress, 16, 439–443.

Buhi, E. R., Goodson, P., & Neilands, T. B. (2008). Out of sight, not out of mind: Strategies for handling missing data. American Journal of Health Behavior, 32, 83–92.

Castro, C. A., Bienvenu, R., Huffman, A. H., & Adler, A. B. (2000). Soldier dimensions and operational readiness in U.S. Army forces deployed to Kosovo. International Review of the Armed Forces Medical Services, 73, 191–199.

Dörfel, D., Rabe, S., & Karl, A. (2008). Coping strategies in daily life as protective and risk factors for post traumatic stress in motor vehicle accident survivors. Journal of Loss and Trauma, 13, 422–440.

Elliott, P., Biddle, D., Hawthorne, G., Forbes, D., & Creamer, M. (2005). Patterns of treatment response in chronic posttraumatic stress disorder: An application of latent growth mixture modeling. Journal of Traumatic Stress, 18, 303–311.

Feldner, M. T., Lewis, S. F., Leen-Feldner, E. W., Schnurr, P. P., & Zvolensky, M. J. (2006). Anxiety sensitivity as a moderator of the relation between trauma exposure frequency and posttraumatic stress symptomatology. Journal of Cognitive Psychotherapy, 20, 201–213.

Freedman, S. A., Brandes, D., Peri, T., & Shalev, A. (1999). Predictors of chronic post-traumatic stress disorder: A prospective study. British Journal of Psychiatry, 174, 353–359.

Gray, M. J., Litz, B. T., Hsu, J. L., & Lombardo, T. W. (2004). Psychometric properties of the Life Events Checklist. Assessment, 11, 330–341.

Harnish, J. D., Aseltine, R. H., & Gore, S. (2000). Resolution of stressful experiences as an indicator of coping effectiveness in young adults: An event history analysis. Journal of Health and Social Behavior, 41, 121–136.

Jung, T., & Wickrama, K. A. S. (2008). An introduction to latent class growth analysis and growth mixture modeling. Social and Personality Psychology Compass, 2, 302–317.

King, D. W., King, L. A., Erickson, D. J., Huang, M. T., Sharkansky, E. J., & Wolfe, J. (2000). Posttraumatic stress disorder and retrospectively reported stressor exposure: A longitudinal prediction model. Journal of Abnormal Psychology, 109, 624–633.

Krinsley, K. E., Gallagher, J. G., Weathers, F. W., Kutter, C. J., & Kaloupek, D. G. (2003). Consistency of retrospective reporting about exposure to traumatic events. Journal of Traumatic Stress, 16, 399–409.

Kuhn, E., Blanchard, E. B., Fuse, T., Hickling, E. J., & Broderick, J. (2006). Heart rate of motor vehicle accident survivors in the emergency department, peritraumatic psychological reactions, ASD, and PTSD severity: A 6-month prospective study. Journal of Traumatic Stress, 19, 735–740.

LeardMann, C. A., Smith, T. C., Smith, B., Wells, T. S., & Ryan, M. A. K. (2009). Baseline self reported functional health and vulnerability to post-traumatic stress disorder after deployment: Prospective US military cohort study. British Medical Journal, 338, 1–9.

Litz, B. T. (2004). Early intervention for trauma and traumatic loss. New York: Guilford Press.

Litz, B. T., & Schlenger, W. E. (2009). Posttraumatic stress disorder in service members and new veterans of the Iraq and Afghanistan Wars: A bibliography and critique. PTSD Research Quarterly, 20(1), 1–7.

McTeague, L. M., McNally, R. J., & Litz, B. T. (2004). Prewar, war-zone, and postwar predictors of posttraumatic stress in female Vietnam veteran health care providers. Military Psychology, 16, 99–114.

Muthén, B., & Muthén, L. (2000). Integrating person-centered and variable-centered analyses: Growth mixture modeling with latent trajectory classes. Alcoholism: Clinical and Experimental Research, 24, 882–891.

Orcutt, H. K., Erickson, D. J., & Wolfe, J. (2004). The course of PTSD symptoms among Gulf War veterans: A growth mixture modeling approach. Journal of Traumatic Stress, 17, 195–202.

Orth, U., & Wieland, E. (2006). Anger, hostility, and posttraumatic stress disorder in trauma-exposed adults: A meta-analysis. Journal of Consulting and Clinical Psychology, 74, 698–706.

Ozer, E. J., Best, S. R., Lipsey, T. L., & Weiss, D. S. (2003). Predictors of posttraumatic stress disorder and symptoms in adults: A meta-analysis. Psychological Bulletin, 129, 52–73.

Radloff, L. (1977). The CES-D Scale: A self-report depression scale for research in the general population. Applied Psychological Measurement, 1, 385–401.

Ryan, M. A., Smith, T. C., Smith, B., Amoroso, P., Boyko, E. J., Gray, G. C., et al. (2007). Millennium cohort: Enrollment begins a 21-year contribution to understanding the impact of military service. Journal of Clinical Epidemiology, 60, 181–191.

Santor, D. A., & Coyne, J. C. (1997). Shortening the CES-D to improve its ability to detect cases of depression. Psychological Assessment, 9, 233–243.

Smith, T. C., Ryan, M. A., Wingard, D. L., Slymen, D. J., Sallis, J. F., & Kritz-Silverstein, D. (2008). New onset and persistent symptoms of posttraumatic stress disorder self-reported after deployment and combat exposures: Prospective population-based US military cohort study. British Medical Journal, 336, 366–371.

Smith, T. C., Wingard, D. L., Ryan, M. A., Kritz-Silverstein, D., Slymen, D. J., & Sallis, J. F. (2008). Prior assault and posttraumatic stress disorder after combat deployment. Epidemiology, 19, 505–512.

Straus, M. A. (1979). Measuring intrafamily conflict and violence: The Conflict Tactics (CT) Scales. Journal of Marriage and Family, 41, 75–88.

Switzer, F. S., & Roth, P. L. (2002). Coping with missing data. In S. G. Rogelberg (Ed.), Handbook of research methods in industrial and organizational psychology (pp. 310–323). New York: Wiley.

Tellegen, A. (1982). Brief manual for the Differential Personality Questionnaire. Unpublished manuscript, Minneapolis, MN.

Weathers, F. W., Litz, B. T., Herman, D. S., Huska, J. A., & Keane, T. M. (1993, November). The PTSD Checklist (PCL): Reliability, validity, and diagnostic utility. Paper presented at the International Society for Traumatic Stress Studies, San Antonio, TX.

Zlotnick, C., Rodriguez, B. F., Weisberg, R. B., Bruce, S. E., Spencer, M. A., Culpepper, L., et al. (2004). Chronicity in posttraumatic stress disorder and predictors of the course of posttraumatic stress disorder among primary care patients. Journal of Nervous and Mental Disease, 192, 153–159.